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SWEETPOTATO PROPAGATION AND TRANSPLANTING STUDIES

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PRODUCTIVITY OF SUCCESSIVE PULLINGS OF SPROUTS[1]

STATEMENT OF THE PROBLEM

Varieties of sweetpotato differ in the profusion of sprouts they will produce when properly bedded for the production of plants or "draws" for transplanting. In general, however, it probably requires 10 to 12 bushels of medium-size roots to produce enough suitable sprouts at a single pulling to plant an acre of land. By making two pullings, or even three, at intervals of 2 to 3 weeks, the total production of sprouts per bushel of seed stock can be so increased that 6 to 8 bushels will be adequate for each acre transplanted. It has been observed that fields or portions of fields planted with draws from the second or third pulling usually do not yield as well as those planted with draws from the first. Is this generally inferior yield from second- and third-pulling sprouts because of their inherent lower productivity, or is it chiefly the result of their being transplanted later? The present study was designed to answer this question by furnishing a comparison of first-, second-, and third-pulling sprouts, all transplanted the same day under uniform field conditions.

METHODS

The studies were conducted from 1932 to 1935, inclusive, at the Pee Dee Experiment Station at Florence, S. C., with the Porto Rico, Nancy Hall, and Big Stem Jersey varieties, on Norfolk and Orangeburg sandy

[1] Investigations conducted under cooperative arrangement with the South Carolina Agricultural Experiment Station.

loam soils. Plantings of each pulling of each variety were replicated at random six times, except in 1935 when they were replicated four times. Each variety was planted in a solid block to avoid undesirable effects of competition resulting from differences in growth habit. Individual plots consisted of eight rows 15 feet long, and records were made on the six inner rows. The rows were 4 feet apart and the plants a foot apart in the rows. Before planting, 500 pounds per acre of a 3–8–9 [2] fertilizer was worked into the ridges.

The exact dates of bedding seed stock and of setting the plants in the field varied slightly from year to year, depending upon weather conditions. Three beddings were made at intervals of approximately 3 weeks, beginning in mid-April, and the sprouts from all three lots of seed stock were planted on the same day, approximately 3 weeks after the last lot was bedded. At the time of bedding the second and the third lots of seed stock, the sprouts were pulled rather closely from the first and from the first and second beddings, respectively, and discarded. Thus, at the time of planting, a third pulling of sprouts was available from the first bedding, a second pulling from the second bedding, and a first pulling from the last lot, all lots of plants being of comparable size. The plants were set in the field the latter half of June, which is rather late for obtaining maximum yields in the section where this work was done. Yields in general were good to only fair, but comparable conditions prevailed among the treatments and varieties.

The plots were harvested the latter part of October or the first part of November, and the roots from each plot were graded into oversize or "Jumbo" roots,[3] U. S. No. 1, and U. S. No. 2 grades and weighed. The strings were left in the field.

The yield data were analyzed by Snedecor's [4] modification of Fisher's method of analysis of variance.

RESULTS

The mean yields per plot of the sextuplicate or quadruplicate plots of each treatment, variety, and year are shown in tables 1 and 2. Inspection of the total yields (table 1) and of those of each grade (table 2) shows very small differences among the treatments (pullings), particularly in the 4-year mean values at the bottom of the tables. Furthermore, since these minor differences appearing between pullings in single varieties and years are in many instances contrary to those in the mean values, it would seem at once that no significance can be attached to differences between treatments.

[2] 3 percent nitrogen, 8 percent phosphoric acid, and 9 percent potash.

[3] Whenever grades are mentioned in this circular they refer to the size requirements of the U. S. Jumbo, U. S. No. 1, and U. S. No. 2 grades issued by the Bureau of Agricultural Economics, U. S. Department of Agriculture, Sept. 8, 1925.

[4] SNEDECOR, GEORGE W. CALCULATION AND INTERPRETATION OF ANALYSIS OF VARIANCE AND COVARIANCE, 96 pp. Ames, Iowa. 1934. (Iowa State Col., Div. Indus. Sci. Monog. 1.)

TABLE 1.—*Yield of sweetpotatoes produced by sprouts of first, second, and third pullings from plant bed, 1932–35*

[Plots replicated 6 times]

Year	Variety	Yield [1] from sprouts of—		
		First pulling	Second pulling	Third pulling
		Pounds	*Pounds*	*Pounds*
1932	Porto Rico	135.3	113.0	119.0
	Nancy Hall	121.5	111.9	110.8
	Big Stem Jersey	118.3	117.5	106.2
	Mean	125.0	114.2	112.0
1933	Porto Rico	58.7	64.7	63.5
	Nancy Hall	69.0	68.5	62.2
	Big Stem Jersey	53.3	57.0	65.0
	Mean	60.3	63.3	63.6
1934	Porto Rico	99.8	100.5	112.3
	Nancy Hall	119.8	126.0	115.4
	Big Stem Jersey	109.0	118.3	113.8
	Mean	109.5	114.9	113.8
1935 [2]	Porto Rico	47.5	50.2	50.8
	Nancy Hall	54.0	54.5	54.5
	Big Stem Jersey	58.0	60.5	57.0
	Mean	53.2	55.1	54.1
	4-year mean	87.1	86.9	85.9

[1] Expressed in pounds per 0.008-acre plot.
[2] Plots replicated 4 times.

TABLE 2.—*Productivity of sweetpotato sprouts of first, second, and third pullings, 1932–35*

[Plots replicated 6 times]

Year	Variety	Yield [1]								
		Jumbo			No. 1			No. 2		
		First pulling	Second pulling	Third pulling	First pulling	Second pulling	Third pulling	First pulling	Second pulling	Third pulling
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1932	Porto Rico	39.5	20.5	31.5	78.5	74.7	71.3	17.3	17.8	16.2
	Nancy Hall	20.8	15.8	16.0	68.5	66.3	59.3	32.2	29.8	35.5
	Big Stem Jersey	5.7	6.2	4.5	68.3	69.8	65.5	44.3	41.5	36.2
	Mean	22.0	14.2	17.3	71.8	70.3	65.4	31.3	29.7	29.3
1933	Porto Rico	0	0	0	43.0	44.5	45.0	15.7	20.2	18.5
	Nancy Hall	0	0	0	47.2	46.5	40.7	21.8	22.0	21.5
	Big Stem Jersey	0	0	0	33.5	37.0	36.0	19.8	20.0	29.0
	Mean	0	0	0	41.2	42.7	40.6	19.1	20.7	23.0
1934	Porto Rico	17.8	22.0	24.0	67.7	65.8	73.3	14.3	12.7	15.0
	Nancy Hall	6.3	9.5	7.7	95.2	97.0	85.2	18.3	19.5	22.5
	Big Stem Jersey	5.7	5.0	4.3	82.0	89.2	83.0	21.3	24.2	26.5
	Mean	9.9	12.2	12.0	81.6	84.0	80.5	18.0	18.8	21.3
1935 [2]	Porto Rico	10.0	8.5	9.5	25.2	29.2	27.5	12.2	12.5	13.8
	Nancy Hall	9.7	10.2	8.8	32.2	30.2	33.8	12.0	14.0	12.0
	Big Stem Jersey	9.7	9.0	6.5	30.5	33.8	33.2	17.8	17.8	17.2
	Mean	9.8	9.2	8.3	29.3	31.1	31.5	14.0	14.7	14.3
	4-year mean	10.4	8.9	9.4	55.9	57.0	54.5	20.6	21.0	22.0

[1] Expressed in pounds per 0.008-acre plot.
[2] Plots replicated 4 times.

Table 3 presents the results of analysis of variance of 4 years' data involving quadruplicate plots. The last two replications of the 1932 to 1934 studies were dropped from the analysis in order to simplify the computations and adhere to a preferable method. The 3 years' results for which six replications were available were analyzed by using only four replications as well as by using six, and the conclusions to be drawn were identical. Of course, differences existed in magnitudes of the several mean squares determined by the two methods, but in no instance did an insignificant variance become changed to a significant one, or vice versa. Table 3 is, therefore, considered to be a presentation of an adequate statistical test of the results of the 4 years' field studies.

TABLE 3.—*Analysis of variance of data in tables 1 and 2* [1]

Source of variation	Degrees of freedom	Mean squares for—		
		Total yield	No. 1	No. 2
Total	143	991.37	563.93	91.18
Between pullings	2	.67	48.03	69.80
Between varieties	2	[2] 582.98	[2] 445.53	[2] 1,651.09
Between years	3	[2] 431.90	[2] 21,563.24	[2] 1,519.75
Between replicates	3	[2] 339.80	[2] 222.72	[2] 126.56
Pullings × years	6	[2] 385.02	68.66	34.62
Varieties × years	6	[2] 666.30	[2] 974.32	[2] 216.66
Pullings × varieties	4	134.74	40.58	9.67
Remainder (error)	117	99.93	67.33	26.60

[1] Analysis involves quadruplicate plots 4 years; 2 replications omitted from 1932 to 1934 data.
[2] Significant with reference to remainder error.

Table 3 shows that there were no significant differences between means of pullings. Stated differently, in the 4-year study as a whole, all three pullings of sprouts were of essentially equal crop-producing capacity.

Highly significant variances in total yield, No. 1 and No. 2 grades, were due to varieties, to seasons (years), to replications, and to varieties × years. There was also a significant interaction between pullings and years, as reflected in total yield. Variance due to pullings × years was significantly larger than that due to pullings. Thus, although the three pullings were generally of equal value, there was at least 1 year in which significant differences appeared in the total yield.

The required magnitude of a significant difference between means of total yields in a single year is 8.2 pounds.[5] By this criterion the first pulling in 1932 was more productive than the second or third. Analysis of the 1932 results alone also showed that the first pulling produced significantly more jumbos than did the second or third. The reason for significant differences appearing for total yields and jumbos between pullings in 1932 is unknown. In succeeding single years and for the 4-year total, variances due to pullings were extremely small and insignificant.

CONCLUSION

Sweetpotato sprouts or draws from first, second, and third pullings appear to be of equal crop-producing power when they are of comparable size and when all are transplanted at the same time so as to avoid differences in productivity resulting from differences in transplanting

[5] Calculated as twice the standard error of a difference between means.

date. Any disadvantages in yields that have been observed from second or third pullings of sprouts would therefore seem to be due principally to the later transplanting in comparison with first pullings. Delayed transplanting has been amply proved elsewhere to result in lower yields [6] (p. 11). Later pullings of sprouts may also be less productive in some instances as a result of pulling the plant beds too closely and using plants of inferior development. In attempts to avoid the undesirable results of late planting as much as possible, the grower may resort to making a second or third pulling before the plants have reached the most satisfactory size for transplanting, and thereby suffer losses from a different cause.

PRODUCTIVITY OF LARGE VERSUS MEDIUM SPROUTS

STATEMENT OF THE PROBLEM

In this circular "large" plants refer to sweetpotato draws or sprouts that are sturdy in appearance and 9 to 10 inches long; "medium" plants refer to draws of good vigor 6 to 7 inches long. These measurements apply to the length of the sprout from the growing point to the point of attachment to the mother root.

It has been often observed that very small draws, those appreciably shorter than 6 inches, may suffer considerable loss from breakage in removal from the plant beds. They are likely to be so soft and tender as to suffer considerably in handling and transplanting after pulling, and furthermore, they can be handled with less facility and speed in transplanting. For these reasons they are generally considered unsuitable. There is less agreement, however, concerning the relative merits of medium versus large plants of the approximate sizes indicated above. Proponents can be found for the use of either size, each insisting upon the superiority of one or the other. In general, comparatively little attention is given to size so long as the plants are large enough to be easily handled (6 to 7 inches) and are not so overgrown as to present supposedly excessive leaf or stem area to evaporation upon transplanting, or to require more laborious transplanting (in order to cover the excessive length of plant). Plants 11 to 12 inches long or larger are troublesome to handle and unless transplanted with most of their length in the soil are often subject to severe drying out and loss of stand. The production of very large draws compels either delayed transplanting or earlier bedding of seed stock with higher costs of bed maintenance and operation. Therefore, there seemed to be little justification for doubling the size of the present experiments by including very small and excessively large plants.

METHODS

These studies were conducted at the United States Horticultural Station near Beltsville, Md., on a moderately fertile sandy loam soil from 1933 to 1935, inclusive. The Porto Rico, Nancy Hall, and Yellow Jersey varieties were grown.

Sufficient seed stock was bedded in early April each year to permit easy selection of the desired sizes of plants upon a single pulling from the bed. Immediately upon removal from the bed, the draws or

[6] MILLER, JULIAN C., and KIMBROUGH, W. D. SWEET POTATO PRODUCTION IN LOUISIANA. La. Agr. Expt. Sta. Bull. 281, 23 pp., illus. 1936.
WOODARD, OTIS. SWEET POTATO CULTURE IN THE COASTAL PLAIN OF GEORGIA. Ga. Coastal Plain Expt. Sta. Bull. 17. 52 pp., illus. 1932.

sprouts were rapidly sorted and the required number of the desired sizes selected for planting. In 1934 the Yellow Jersey variety and in 1935 the Porto Rico variety were planted 2 weeks later than the respective other two varieties in each year because of an insufficient supply of plants at the earlier dates. (See table 4 and p. 7.)

Individual plots consisted of four rows, each 30 feet long, with 4-foot intervals between plots. The rows were 4 feet apart and the plants a foot apart in the row. The experimental area was uniformly fertilized each year in accordance with local practice.

In each season the plots were all transplanted within a few hours and an effort was made to have each man engaged in the transplanting work transplant a proportionate part of each plot. The plants were set in the field the last of May or the early part of June and harvested about October 20 each year. As the plots were harvested the roots were graded into two grades—No. 1 and "other."

Plant sizes were replicated six times for each variety that was planted in a solid block. Yield data were recorded on the two middle rows of each plot and analyzed by the same methods mentioned on page 2.

RESULTS

In 1933, about 5 weeks after transplanting, the large-plant plots appeared to be distinctly more advanced in vine growth than the medium-plant plots. This apparent advantage, if real, was only temporary, however, as will be shown. No marked differences were noted in the other years.

The mean yields of the sextuplicate plots of each plant size for each variety and year are presented in table 4, and the analysis of variance of the data entering into that table is shown in table 5.

TABLE 4.—*Yield of No. 1 grade and total yield of sweetpotatoes produced by large- and medium-sized plants*

[Plots replicated 6 times]

Year	Variety	Yield [1] per plot			
		Total from—		No. 1 grade from—	
		Large plants	Medium plants	Large plants	Medium plants
		Pounds	*Pounds*	*Pounds*	*Pounds*
1933	Porto Rico	62.6	64.4	39.9	44.3
	Nancy Hall	79.4	75.4	55.2	48.2
	Yellow Jersey	77.7	67.7	38.3	39.3
	Mean	73.2	69.2	44.4	43.9
1934	Porto Rico	147.6	134.4	102.6	96.9
	Nancy Hall	150.6	156.9	121.3	121.5
	Yellow Jersey	94.9	74.9	48.7	40.9
	Mean	131.1	122.1	90.9	86.4
1935	Porto Rico	115.9	97.5	80.1	58.7
	Nancy Hall	176.4	150.8	138.7	117.7
	Yellow Jersey	174.5	194.1	105.4	115.0
	Mean	155.6	147.5	108.1	97.1
	3-year mean	120.0	112.9	81.0	75.8

[1] Expressed in pounds per 0.005-acre plot.

TABLE 5.—*Analysis of variance of data in table 4*

Source of variation	Degrees of freedom	Mean squares for—	
		Total yield	No. 1
Total	107	2,286.36	1,501.02
Between sizes	1	1,347.61	757.37
Between varieties	2	[1] 7,139.21	[1] 13,287.52
Between years	2	[1] 60,851.42	[1] 33,496.34
Between replications	5	981.93	541.63
Years × varieties	4	[1] 14,465.78	[1] 8,418.11
Years × sizes	2	61.56	248.86
Varieties sizes	2	546.14	269.14
Remainder (error)	89	486.78	323.23

[1] Significant with reference to remainder error.

The 3-year mean yields at the bottom of table 4 appear to indicate a superiority of large over medium-sized plants in both total and No. 1 yield, and the yearly means point the same way. It should be noted, however, that in three out of nine cases, medium plants gave a larger total yield, and in four out of nine a larger yield of No. 1 than did the large plants. Inconsistencies in behavior among the replicates are not shown in the condensed data (table 4).

Table 5 shows that all these inconsistencies result in such a high variance for error that differences between means of sizes are of no significance. In other words, the two sizes of plants compared here were about equal in productivity, the mean differences being no greater than could be accounted for on the basis of chance.

It is also of interest in table 5 that variances due to the interactions of years × sizes and varieties × sizes were not significant. These show that the relative behavior of the two plant-size groups was consistent for all varieties in the 3-year period as a whole, and in all years for the three varieties as a group.

It is quite noticeable (table 4) that the delayed planting of the Yellow Jersey in 1934 and Porto Rico in 1935 resulted in yields far below those of the other varieties in the respective years. This is largely responsible for the high variance due to years × varieties in table 5. The delayed planting must be kept in mind instead of interpreting that high variance as the markedly different varietal response to season which it might suggest.

CONCLUSION

There is no significant difference in productivity of sweetpotato sprouts or draws 6 to 7 inches long, as compared with those 9 to 10 inches long, provided they are all sturdy and vigorous. Differences in length that are accompanied by marked differences in stem diameter, woodiness, or other characters might well result in significant differences in yield.

INFLUENCE OF SPACING ON YIELD AND GRADE OF THE PORTO RICO SWEETPOTATO

INTRODUCTION

Detailed reports of these investigations on effect of spacing and of those on time of transplanting (p. 11),which were conducted cooperatively by the Bureau of Plant Industry and the South Carolina

Agricultural Experiment Station, have been published.[7] Even at the risk of some repetition, it seems desirable to present in this and the following section a brief analysis of that work, in simple form, in order to bring together in a single publication the salient points of all the sweetpotato propagation and planting studies conducted recently by the writers and their associates.

STATEMENT OF THE PROBLEM

In order to keep down the cost of production per unit of harvested crop, the grower desires the largest practicable yield of marketable sweetpotatoes that can be obtained with the smallest practicable number of plants and labor outlay. Very wide spacing saves on cost of plants per acre, but it is thought to result in too many roots of Jumbo size. Very close spacing involves higher cost of plants and transplanting per acre. These studies were designed to determine what spacing will yield the most No. 1's without excessive cost under average conditions.

METHODS

The spacing studies were conducted from 1928 to 1931 at Florence, S. C., with the Porto Rico variety, which was used because it is the principal variety grown in the South. Varieties of markedly different growth habit might have given different results. Systematically distributed quadruplicate plots, each of four 90-foot rows spaced 4 feet apart, were planted with the plants spaced 6, 9, 12, and 15 inches apart in the rows. The plants were grown on low ridges and in accordance with locally recommended fertilizer and cultural practices. The tests occupied a different area of soil each year.

RESULTS

Table 6 shows the mean yield of the quadruplicate plots for each grade and year, together with means of all treatments in each year and means of all years for each spacing. As the spacing increases from 6 to 15 inches, the yields of Jumbos generally increase, No. 1's remain nearly the same, and No. 2's decrease.

Table 7 presents the analysis of variance of the values in table 6. It shows that the differences in Jumbos and No. 2 yields between spacings are significant, but that differences in No. 1 and total yield are no more than can be accounted for by chance. As is usual in field-plot work, the greatest differences occurred between years. The insignificant variances due to the interaction of spacing $\times$ years is of particular interest, indicating quite consistent relative yields among the several spacings year after year. In other words, the relative response to spacing was not significantly affected by differences in weather and soil conditions from year to year, although the yields of the experiment as a whole varied quite widely.

The calculated magnitude of differences required for significance between means shows (table 6) that none are significant between 6- and 9-inch, 9- and 12-inch, or between 12- and 15-inch spacings, but 12- and 15-inch yielded more Jumbos and less No. 2's than the 6-inch spacing.

[7] BEATTIE, J. H., BOSWELL, VICTOR R., and HALL, E. E. INFLUENCE OF SPACING AND TIME OF PLANTING ON THE YIELD AND SIZE OF THE PORTO RICO SWEETPOTATO. U. S. Dept. Agr. Cir. 327, 11 pp. 1934.

TABLE 6.—*Effect of spacing in the row on yield per acre of different grades of sweetpotatoes, Florence, S. C., 1928–31*

[Quadruplicate plots]

Year	Grade	Yield per acre from spacing indicated				
		6 inches	9 inches	12 inches	15 inches	Mean [1]
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*
1928	Jumbo	6.0	8.5	13.7	9.8	9.5
	No. 1	55.8	55.4	52.7	49.0	53.2
	No. 2	12.5	8.9	9.3	7.2	9.5
	Total	74.2	72.8	75.6	66.0	72.2
1929	Jumbo	10.2	15.0	16.0	24.8	16.5
	No. 1	156.5	144.9	145.3	175.6	155.6
	No. 2	47.8	30.8	24.3	29.2	33.0
	Total	214.5	190.6	185.6	229.7	205.1
1930	Jumbo	6.3	10.7	13.1	17.3	11.9
	No. 1	118.4	112.9	118.8	109.1	114.8
	No. 2	47.4	46.4	49.9	42.1	46.4
	Total	172.1	170.0	181.8	168.5	173.1
1931	Jumbo	22.8	19.3	28.9	26.8	24.5
	No. 1	109.1	86.2	88.2	91.2	93.7
	No. 2	41.7	37.7	21.3	26.8	31.9
	Total	173.6	143.1	138.4	144.9	150.0
4-year mean	Jumbo	11.3	13.4	17.9	19.7	15.6
	No. 1	110.0	99.9	101.2	106.2	104.3
	No. 2	37.3	30.9	26.2	26.4	30.2
	Total	158.6	144.2	145.4	152.3	150.1

[1] Differences required for significance between years or spacings are as follows: For Jumbos, 5.7 bushels; for No. 1's, 11.5 bushels; for No. 2's, 8 bushels; for totals, 14.6 bushels.

TABLE 7.—*Analysis of variance of data in table 6*

Source of variation	Degrees of freedom	Mean squares for—			
		Jumbo	No. 1	No. 2	Total
Total	63	103.78	1,663.05	317.36	2,912.18
Between spacings	3	[1] 242.02	345.56	[1] 440.89	720.66
Between years	3	[2] 694.00	[2] 29,132.03	[2] 3,746.71	[2] 51,330.96
Between replications	3	154.38	433.64	192.19	481.31
Spacings × years	9	34.95	350.83	126.54	742.37
Remainder (error)	45	65.54	264.02	127.02	426.38

[1] Significant with reference to error; odds greater than 19 : 1, but less than 99 : 1.
[2] Significant with reference to error; odds greater than 99 : 1.

Table 8 shows the percentage of total yield constituted by each grade, and table 9 presents the analysis of variance of those data. The occurrence of differences between spacings and of significances among them are essentially the same as in the case of yields per acre. As the spacing increased, the percentage of Jumbos increased and of No. 2's decreased. The mean percentage of No. 1's was remarkably constant among the several spacings, although it varied appreciably from year to year. Again, interaction between spacings and years was quite insignificant. It should be noted that in table 8 the mean values are unweighted mean percentages, which in this instance are superior to

weighted means for showing tendencies of single crops over a period of years.

TABLE 8.—*Effect of planting distance on percentage distribution of different grades of sweetpotatoes, Florence, S. C., 1928–31*

[Quadruplicate plots]

Year	Grade	Percentage of total yield consisting of grade indicated when planted at distances shown				
		6 inches	9 inches	12 inches	15 inches	Means [1]
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1928	Jumbo	8.0	12.0	18.5	15.1	13.4
	No. 1	74.5	75.7	69.4	73.9	73.4
	No. 2	17.5	12.3	12.1	11.0	13.2
1929	Jumbo	4.7	8.1	8.6	10.9	8.1
	No. 1	73.1	75.7	78.4	76.6	75.9
	No. 2	22.2	16.2	13.0	12.5	16.0
1930	Jumbo	3.7	6.5	7.7	11.0	7.2
	No. 1	69.7	66.9	65.7	63.9	66.6
	No. 2	26.6	26.6	26.6	25.1	26.2
1931	Jumbo	13.1	13.3	20.1	18.3	16.2
	No. 1	62.5	60.4	64.4	63.0	62.5
	No. 2	24.4	26.3	15.5	18.7	21.3
4-year mean	Jumbo	7.4	10.0	13.7	13.8	11.2
	No. 1	69.9	69.7	69.5	69.3	69.6
	No. 2	22.7	20.3	16.8	16.9	19.2

[1] Differences required for significance between years or spacings are as follows: For Jumbos, 4 percent; for No. 1's, 4.5 percent; for No. 2's, 3.9 percent.

TABLE 9.—*Analysis of variance of data in table 8*

Source of variation	Degrees of freedom	Mean squares for—		
		Jumbo	No. 1	No. 2
Total	63	50.67	66.72	50.11
Between distances	3	[1] 156.90	1.15	[2] 131.76
Between years	3	[1] 294.11	[1] 604.02	531.58
Between replications	3	[2] 110.04	[2] 115.87	30.33
Distances × years	9	9.85	27.80	26.51
Remainder (error)	45	31.56	39.78	29.80

[1] Significant with reference to error; odds greater than 99:1.
[2] Significant with reference to error; odds greater than 19:1, but less than 99:1.

CONCLUSION

Among spacing distances of 6, 9, 12, and 15 inches in the row, the total yield and the yield and the percentage of No. 1 grade of Porto Rico sweetpotato remained practically constant when grown in rows 4 feet apart under South Carolina Coastal Plain conditions. As the spacing increased, the yield and percentage of Jumbos increased and the yield and percentage of No. 2's decreased significantly. No significant differences in crop behavior occurred between plots differing by less than 6 inches in spacing. These results were quite consistent for the 4 years of the experiment.

INFLUENCE OF TIME OF TRANSPLANTING ON YIELD AND GRADE OF THE PORTO RICO SWEETPOTATO

STATEMENT OF THE PROBLEM

Since the sweetpotato is a long-season crop with a high temperature requirement, it is generally realized that if it is to make a good yield in the more northerly sweetpotato-growing States it should be planted in the field as promptly as is safe after the frost-free date. Experience of growers indicates that generally about 10 days after the frost-free date (not the average date of the last killing frost) the weather is warm enough for planting. Delaying planting much beyond June 1 in the northerly areas is known to allow too little time for developing good yields, but in the southern sweetpotato-growing areas where the seasons are longer, the importance of early planting has not been sufficiently emphasized.

The present studies were conducted to determine the effect of time of transplanting to the field upon yield and grade under South Atlantic Coastal Plain conditions. It is believed that the results obtained are applicable to regions having temperatures similar to those prevailing in the Coastal Plain area from Norfolk, Va., to Savannah, Ga., and at low altitudes from the Carolinas westward.

METHODS

Plot sizes, replications, and cultural practices were the same as described on page 8. Plantings were made with the Porto Rico variety at Florence, S. C., May 15, May 30, June 15, June 30, and July 15, in 1930, 1931, and 1932.

In order to have plants as nearly alike as possible for all plantings, seed stock was bedded separately for each planting a month before the plants were to be set in the field. Although the later beddings produced more large plants in a month than did the earlier lots, care was taken to use only fairly uniform, stocky, medium-sized plants from all beddings to avoid yield differences that might result from differences in plant size. The results later obtained in studying the effect of plant size (p. 5) indicate that the precautions taken were adequate to avoid variation in behavior between plantings as a result of differences in size of plants used.

RESULTS

Table 10 shows the mean yields of each grade and total yields for each planting and year. The 3-year mean yields of Jumbo and No. 1 grades and total yields decreased sharply and significantly for each successive planting after the first. The differences between adjacent planting dates were not always significant within a single year, nor even always in the same direction. Some scheduled planting dates happened to coincide with a period of hot dry weather that had passed before the next planting. In such cases (see May 30 versus June 15, 1930) the later planting might be superior to that immediately preceding it.

TABLE 10.—*Effect of time of transplanting sweetpotatoes upon individual grade and total yields per acre, Florence, S. C., 1930–32*

[Quadruplicate plots]

Year	Grade	Yield per acre for planting date shown—					
		May 15	May 30	June 15	June 30	July 15	Mean [1]
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
1930	Jumbo	124.8	26.3	20.8	7.6	0	35.9
	No. 1	237.6	189.8	221.3	109.8	71.9	166.0
	No. 2	76.6	76.8	61.0	57.5	59.6	66.3
	Total	439.0	292.9	303.1	174.9	131.5	268.2
1931	Jumbo	15.6	14.5	9.8	2.0	0	8.4
	No. 1	140.1	123.0	33.5	30.3	29.0	71.2
	No. 2	48.6	65.4	24.8	23.6	23.5	37.2
	Total	204.4	202.9	68.0	55.9	52.5	116.7
1932	Jumbo	85.9	63.3	55.4	23.5	15.4	48.7
	No. 1	134.0	130.4	95.0	63.0	56.6	95.8
	No. 2	30.6	40.5	42.8	33.1	40.8	37.5
	Total	250.5	234.1	193.1	119.6	112.8	182.0
3-year mean [2]	Jumbo	75.4	34.7	28.7	11.0	5.1	31.0
	No. 1	170.6	147.7	116.6	67.7	52.5	111.0
	No. 2	52.0	60.9	42.8	38.1	41.3	47.0
	Total	298.0	243.3	188.1	116.8	98.9	189.0

[1] Differences required for significance between years are as follows: For Jumbos, 6.3 bushels; for No. 1's, 10.6 bushels; for No. 2's, 5.9 bushels; for totals, 13.2 bushels.

[2] For significance between planting dates the required differences for the 3 grades and for totals are 8.1, 13.7, 7.6, and 17.0 bushels, respectively.

The proportion of the No. 2 grade was different from that of the Jumbo, No. 1, and total yield, in each of the 3 years. The yield of No. 2's in the first planting never exceeded that of the second, and in 2 years it was significantly less. In general, the No. 2 yields dropped off at the third planting (June 15) and remained practically constant through the fifth planting.

Between the May 15 and July 15 plantings there was a decrease of 200 bushels total yield, or a reduction of two-thirds from the first and best planting date. A similar relative decrease occurred in the No. 1 grade. This amounts, roughly, to a loss of about 25 bushels total yield per acre per week of delay in planting, and 15 bushels per acre per week for the No. 1 grade.

Table 11 presents the analysis of variance of data for table 10. With the exception of variances due to replication for Jumbos, No. 1's, and total, all are highly significant with reference to error. The significant variance due to plantings × years shows a real difference in response to a specific planting date in different years; but even so, this interaction variance is significantly smaller than the variance between planting dates for Jumbos, No. 1's, and for total. Thus, although there is some definite fluctuation in differences between plantings from year to year, the earlier plantings for the 3-year period are distinctly superior to the later, except in the No. 2 grade alone. This exception, however, is of minor importance.

TABLE 11.—*Analysis of variance of data in table 10*

Source of variation	Degrees of freedom	Mean squares for—			
		Jumbo	No. 1	No. 2	Total
Total	59	1,310.2	4,445.1	395.4	11,027.4
Between plantings	4	[1] 9,178.7	[1] 30,686.6	[1] 1,043.1	[1] 84,635.7
Between years	2	[1] 8,458.1	[1] 48,475.7	[1] 5,592.9	[1] 115,943.2
Between replications	3	209.2	26.2	[1] 421.4	285.5
Plantings × years	8	[1] 2,354.7	[1] 3,831.2	[1] 445.1	[1] 7,643.7
Remainder (error)	42	98.7	281.8	74.9	432.9

[1] Significant with reference to error by odds greater than 99:1.

Table 12 shows the influence of planting date upon the distribution of grades constituting the total yield. This is perhaps of secondary importance in view of the radical losses in yield of Jumbos and No. 1's that result from delayed planting. It is of interest, however, to note that there are no significant differences in percentage of No. 1's among the first three plantings, while the last two plantings show significant decreases. Jumbos show sharp successive decreases and the No. 2's show sharp increases in percentage that represent significant differences between all but two possible comparisons.

TABLE 12.—*Effect of time of transplanting on yield per plot of different grades of sweetpotatoes expressed as percentage of total plot yield, Florence, S. C., 1930–32*

[Quadruplicate plots]

Year	Grade	Yield of grade indicated as percentage of total plot yield					
		May 15	May 30	June 15	June 30	July 15	Mean[1]
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1930	Jumbo	28.3	9.0	6.9	4.5	0.0	9.7
	No. 1	54.2	64.6	73.1	62.0	52.9	61.6
	No. 2	17.5	26.4	20.0	32.5	47.1	28.7
1931	Jumbo	7.8	6.9	14.1	3.3	0.0	6.4
	No. 1	68.9	60.9	48.8	54.2	55.6	57.4
	No. 2	23.3	32.2	37.1	42.5	44.4	36.2
1932	Jumbo	34.5	27.1	28.1	19.9	13.8	24.7
	No. 1	53.5	55.6	49.0	53.1	50.6	52.4
	No. 2	12.0	17.3	22.9	27.0	35.6	22.9
3-year mean[2]	Jumbo	23.5	14.3	16.3	9.3	4.6	13.6
	No. 1	58.8	60.4	57.0	55.6	53.1	57.1
	No. 2	17.7	25.3	26.7	34.1	42.3	29.3

[1] Differences required for significance between means of years are as follows: For Jumbos, 2.9 percent; for No. 1's, 4.4 percent; for No. 2's, 4.8 percent.

[2] For significance between planting dates the required differences in percentage are 3.2, 4.4, and 4.8, respectively, for the 3 grades.

Table 13 shows the analysis of variance for data in table 12. Variance in percentage of each grade that is due to planting date is significant in every case. The variance for interaction between plantings and years was significant with reference to error only for Jumbos and No. 1's, the relative effect of planting date on percentage of No. 2's being quite consistent year after year. Despite the significance of variance of No. 1's due to planting date for the 3-year period, the date yielding the highest percentage of that grade differed widely (and significantly) from year to year.

TABLE 13.—*Analysis of variance of data in table 12*

Source of variation	Degrees of freedom	Mean squares for—		
		Jumbo	No. 1	No. 2
Total	59	133.89	73.23	137.52
Between plantings	4	[1] 621.05	[2] 96.78	[1] 1,052.18
Between years	2	[1] 1,892.38	[1] 406.45	[1] 850.47
Between replications	3	31.39	29.49	83.88
Plantings × years	8	[1] 110.58	[1] 226.98	59.38
Remainder (error)	42	15.20	28.96	35.17

[1] Significant with reference to error; odds greater than 99 : 1.
[2] Significant with reference to error; odds greater than 19 : 1, but less than 99 : 1.

CONCLUSIONS

Transplanting successive lots of Porto Rico sweetpotatoes in coastal South Carolina at semimonthly intervals from May 15 to July 15 resulted in successive, significant, sharp decreases in yield of Jumbos, No. 1's, and total yield.

The decreases in yield for each 2 weeks' delay in planting averaged, roughly, 30 bushels of No. 1's per acre and 50 bushels total per acre per 2-week interval.

The decreases in yield of No. 2's were slight, although consistent and significant.

The No. 1 and total yields of July 15 plantings averaged but 33 and 31 percent, respectively, of the May 15 plantings.

Changes in distribution of grades accompanying delayed planting were highly significant but of much less striking magnitude than changes in yield. The 3-year mean percentage of No. 1's was nearly constant for the plantings of May 15, May 30, and June 15, but decreased significantly for later plantings. The percentage of Jumbos rapidly decreased with successively later plantings and that of No. 2's increased.

On the basis of these very striking results, growers cannot afford to delay planting appreciably beyond the first part of May in the region indicated.

SUMMARY

Sweetpotato sprouts or draws from first, second, and third pullings appear to be of equal productivity if they are of comparable size when pulled and if they are all planted at the same time so as to avoid the differences in yield resulting from differences in planting date.

The unsatisfactory results that have been obtained with second and third-pulling sprouts in contrast to those of the first pulling are believed to be due chiefly either to delayed planting or to the use of undersized sprouts, or to a combination of both causes.

Sprouts 6 to 7 inches and 9 to 10 inches long were found to be equally productive, provided all were sturdy, vigorous sprouts of otherwise equal quality.

Among spacing distances of 6, 9, 12, and 15 inches in the row, in rows 4 feet apart, the yield and percentage of No. 1 grade of Porto Rico sweetpotato remained practically constant under the conditions of these studies. As the spacing increased the yield and percentage of the oversize or Jumbos increased and the No. 2 grade decreased

significantly, except that no significant differences occurred between spacings differing by less than 6 inches.

Successive 2-week delays in planting from May 15 to July 15 in coastal South Carolina resulted in successively lower yields for the respective plantings of, roughly, 30 bushels of No. 1's and 50 bushels total per acre per 2-week interval. The July 15 plantings yielded only one-third as many bushels of No. 1 grade and total of all sizes as did the May 15 plantings.

Decreases in percentage of No. 1's were less striking than loss in bushels of No. 1's accompanying delayed planting, but they were significant. Delayed planting very markedly decreased the yield and percentage of the Jumbos and increased the percentage of the No. 2 grade.

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